Canon

Service Manual

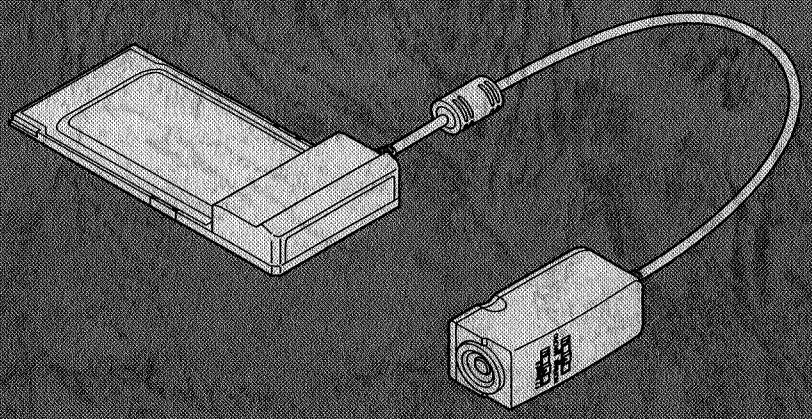
ENGLISH EDITION

CANON DIGITAL CAMERA

PowerShot 30T

Ver.1

F92-1004



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GENERAL

1. Overview

The PowerShot30T is a general-purpose digital card camera developed for use with portable PCs. It has a PCMCIA Type II interface and is compatible with Microsoft® Windows®95 Plug and Play technology. The PowerShot30T is designed for visual communication and video data terminals (visual memos), permitting motion video and high resolution still images to be recorded directly on a PC.

The viewfinder, storage device, filing functions, camera-control software, and CPU power supply required by the digital camera are provided by the host computer. The PowerShot30T costs are thus concentrated on the image-pickup system and camera functions. As a result, the PowerShot30T provides high-quality images in an economical package. Photographing functions can be integrated with business applications to quickly add graphical images to documents.

2. Features

- The PCMCIA Type II interface makes it possible to add digital camera capabilities to a notebook PC simply by inserting the PowerShot30T in a PCMCIA slot.
- Six special Group 5 high-resolution lenses are used to provide images with little distortion.
- A special proprietary graphical digital signal processing IC is used to provide excellent color reproducibility.
- The special proprietary graphical digital signal processing IC permits video recording at a maximum rate of 20 frames per second.
- Images are input directly to the PC, enabling users to check images in real time, add annotations, transfer images, etc.
- The PowerShot30T has a high-sensitivity mode which permits photographing without a flash, even at night under streetlights.
- An electronic viewfinder is integrated in the PC monitor. This makes it possible to frame images correctly, using a larger finder than would be feasible with an ordinary digital camera.
- The PowerShot30T supports the following international standard formats: AVI, JPEG, TIFF, and BMP. Camera images can thus be used in a wide range of applications.
- The PowerShot30T has a thin, lightweight design which doesn't affect the portability of a notebook PC when installed.
- The PowerShot30T is compatible with full color, high color, and 256-color displays.
- The PowerShot30T is Windows 95 Plug and Play compatible.
- The camera head can be separated to permit photographing at the desired angle.
- The supplied camera clip can be used to mount the camera on the PC.
- The supplied camera mount/case makes it easy to photograph business cards.

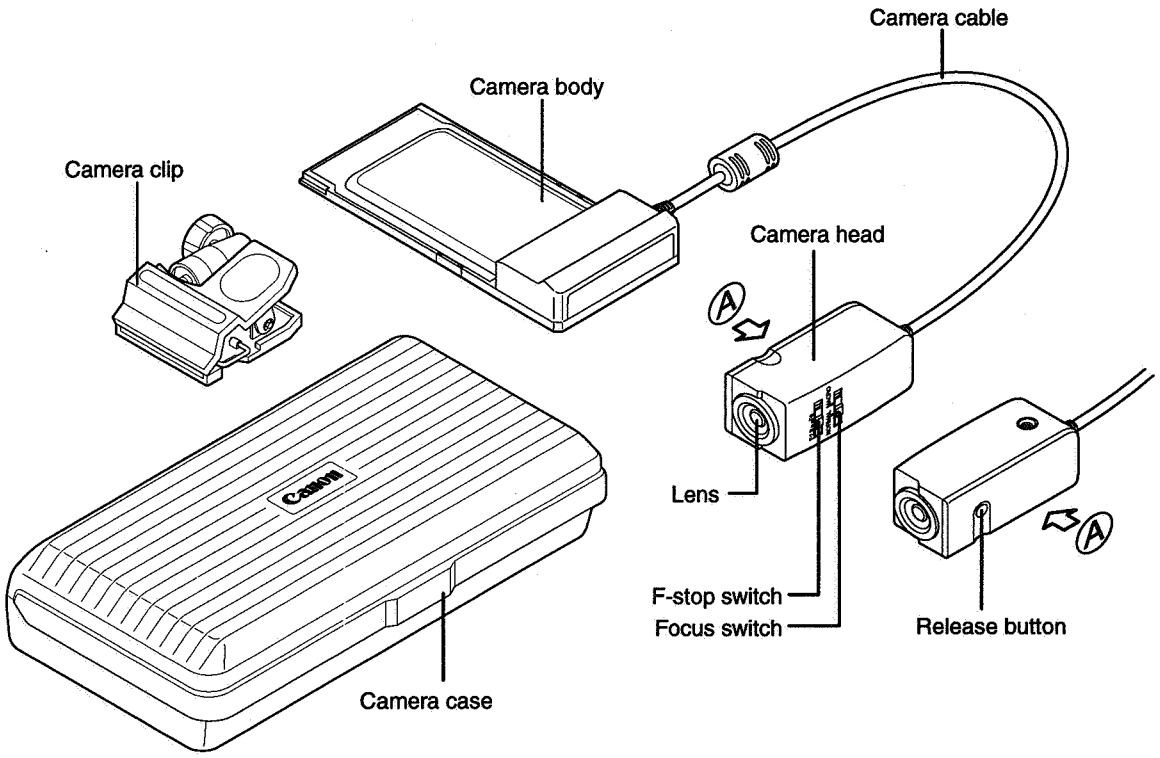
3. Items included in product box

- PowerShot30T
- Camera case
- Camera clip
- Software (six 3.5 Type floppies, CD-ROM)
- Canon PowerShot30T Digital Camera User's Manual
- Canon PowerShot30T Digital Camera User's Guide
- Photo Impact for PowerShot30/30T Supplementary Manual
- User's License
- User Registration Card
- Warranty

4. Specifications

Camera type	: Digital card camera, compatible with PCMCIA Type II slot	
Image pickup device	: 1/4-type 270,000-pixel CCD	
Image sizes	: 80 × 60 pixels, 160 × 120 pixels, 320 × 240 pixels, 640 × 480 pixels	
Color output	: Maximum 24-bit color	
Optical system		
Focal distance	: 5.7 mm (equivalent to approximately 55 mm with a 35 mm camera)	
F-stop	: F2.8 or F8 (manually switched)	
Photographing distance	: 8 cm to infinite	
Exposure control	: Automatic	
Sensitivity	: Equivalent to ISO100	
Focusing	: Normal or macro (manually switched)	
White balance	: Automatic	
Power consumption	: Approximately 1.3 watts	
External dimensions (camera body)		
Card	: 117.6 × 54.0 × 18.4 (mm)	(4 5/8 × 2 1/8 × 3/4 inch)
Cable	: 600 (mm)	(23 5/8 inch)
Camera head	: 60.0 × 30.2 × 26.5 (mm)	(2 3/8 × 1 3/16 × 1 1/16 inch)
Camera case	: 210.0 × 38.5 × 100.7 (mm)	(8 1/4 × 1 1/2 × 3 15/16 inch)
Camera clip	: 43.5 × 25.8 × 68.3 (mm)	(1 11/16 × 1 × 2 11/16 inch)
Weight	: Approximately 120 g (camera body only) (4.23 lb)	
Operating environment		
Temperature	: 5 to 35°C	
Relative humidity	: 20 to 80%	

5. Parts of the camera



TECHNICAL EXPLANATION

1. Block diagram

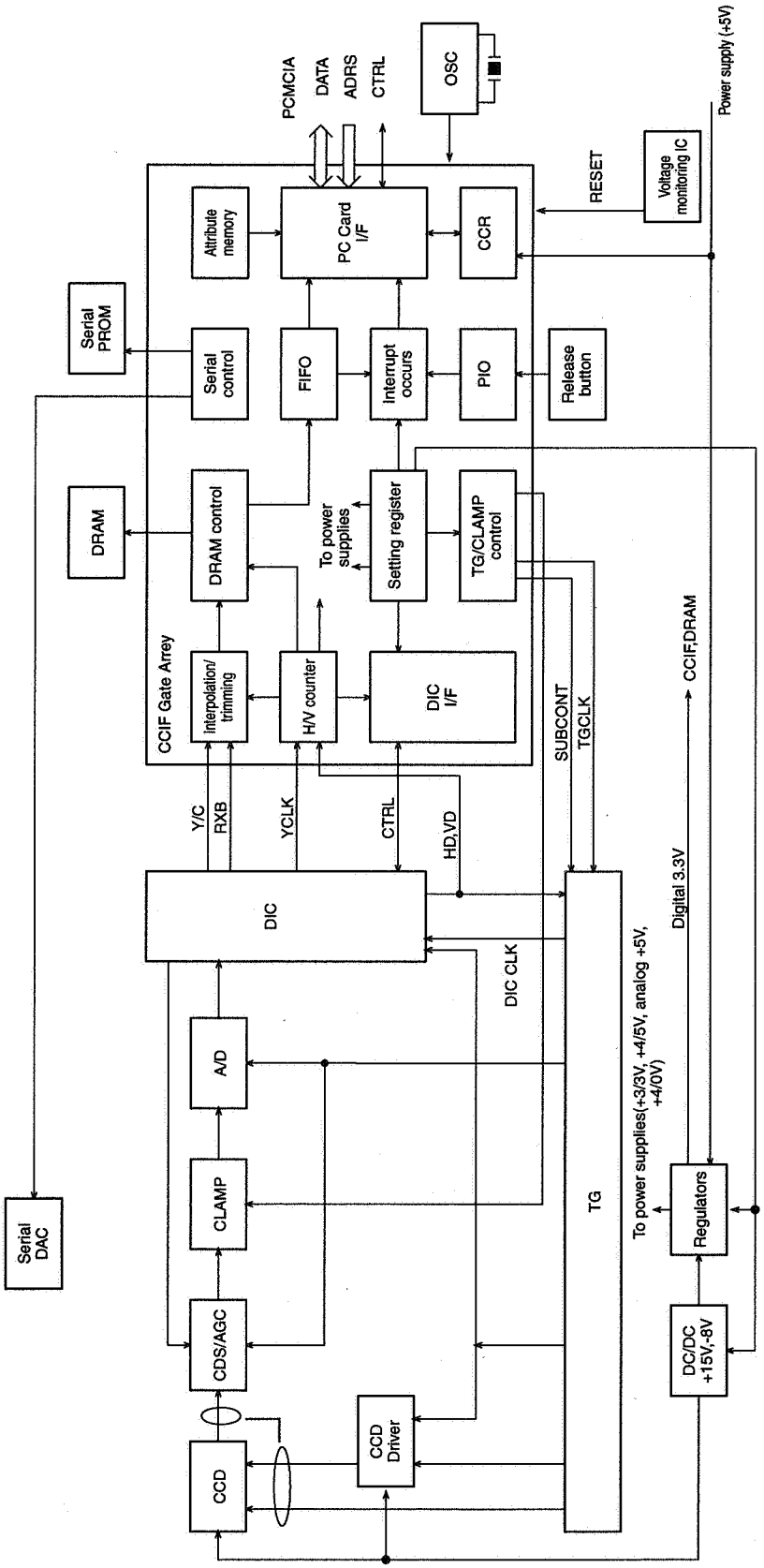


Fig. T-1 Block Diagram

2. Technical explanation

2-1. 270,000-pixel CCD

The PowerShot30T is equipped with a 1/4-type interline-transfer CCD with 270,000 total pixels including 250,000 effective pixels. This type of CCD is widely used in camcorders and allows the PowerShot30T to provide high-quality images at a low cost.

As shown in Figure T-1, the CCD comprises a photographing unit consisting of a photodiode (PD) and a 4-phase driven vertical transfer CCD (VCCD); a horizontal transfer unit (HCCD) consisting of a 2-phase driven CCD; and an output unit which consists of a floating fusion amp. The color filter array consists of an additive-color grid which is driven by a color-difference sequence system, whereby a color-difference signal is obtained by reading two vertical pixels in combination.

Figure T-2-a shows a cross section of the pixel unit. Figure T-2-b is a graph showing the potential across a-a' in the cross section. As illustrated, the sensor uses a vertical overflow drain structure for anti-blooming. This structure also functions as an electronic shutter. When a base potential Vsub (DC) is applied while a signal charge is stored, the p- layer potential wall is set to a height which is suitable for a signal charge at or above a set level to be emitted in the direction of the thickness of the substrate. A base pulse ΔVsub is applied to emit all signal charges in the photodiode in the direction of thickness of the substrate in order to provide the electronic shutter function.

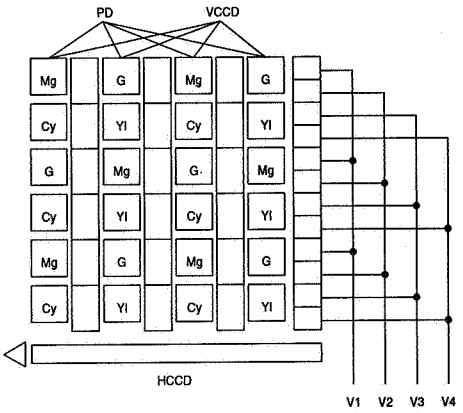


Fig. T-1 CCD Structure

The PowerShot30T does not have a mechanical shutter and has only two fixed F-stop settings. The autoexposure function involves discarding the signal charges and controlling the electronic shutter pulses based on the design described above.

The PowerShot30T's drive speed is set to be slower than that of camcorders in order to match the drive speed of the camera as a whole to the PC's data input speed and display speed.

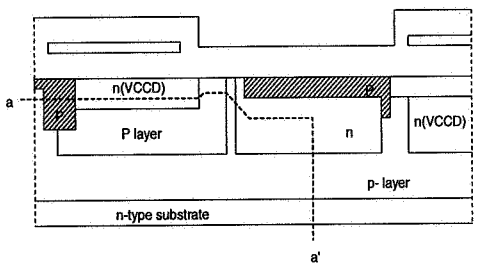


Fig. T-2-a Pixel Cross Section

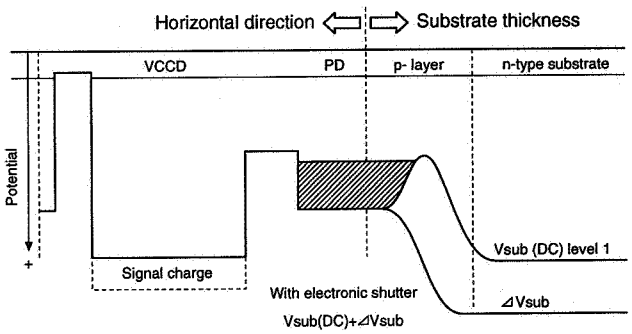


Fig. T-2-b Graph of Potential

2-2. Signal processing system

The PowerShot30T signal processing system involves converting the image signal to brightness/color-difference video signals by means of a single-chip digital signal processing IC (DIC minus) developed by Canon. The converted signals are transferred to the PC through a Card Camera Interface Gate Array (CCIF).

After receiving an image signal which has been digitized by an A/D converter, the DIC processes it internally through a brightness-signal system and a color-difference-signal system. Brightness signals are output for each pixel through a digital parallel port called a future bus. Color-difference signals (R to Y/B to Y) are output every eight bits in point sequence. The DIC also has an internal preprocessor which provides AE and AWB evaluation data. These data can be set and read by the PC through the CCIF. After these data are processed, autoexposure control is achieved by controlling the electronic shutter exposure time, while AWB control is achieved by modifying the DIC's internal parameters. The CCIF operations are described with respect to the block diagram shown in Figure T-1.

■ PCMCIA interface

This device complies with the PCMCIA standard electrical specifications for 16-bit I/O and memory cards.

PCMCIA attribute data are written to memory cells in the CCIF. These data are read by the PC in attribute mode. PC resources (memory space, interrupts, etc.) are then assigned and data are written to the Card Configuration Register (CCR) in the CCIF to configure the camera as an I/O device and memory card. Once these settings are made, the PC camera can be used as part of the computer's I/O and memory space. The CCIF is compatible with the highest-speed version of 16-bit memory cards (100 nanoseconds per word).

■ Image interpolation

Still images must have a square pixel format (1:1 pixel aspect ratio) in order to be used on a PC. However, the number of effective pixels in the image pickup device are 512 (horizontal) by 492 (vertical). Furthermore, the individual pixels are very rectangular in shape, measuring 7.2 microns (horizontal) by 5.6 microns (vertical) (the vertical size is actually twice this amount due to add reading). The CCIF therefore interpolates the pixels in the horizontal direction to obtain a square image. Figure T-3 is a conceptual diagram which illustrates how interpolation works when the brightness signals and color-difference signals are in 320 horizontal pixel mode and 160 horizontal pixel mode, respectively. The interpolation unit receives 480 X 240 pixels corresponding to the center of the field image read from the DIC. The brightness signal and color-difference signal are weighted by the amounts shown in the figures. The brightness signal is weighted in three-pixel cycles, while the color-difference signal is weighted in six-pixel cycles. In these operations, the pixel aspect ratio has a vertical bias of 1.037037, so the width of the image is increased by 3.7%.

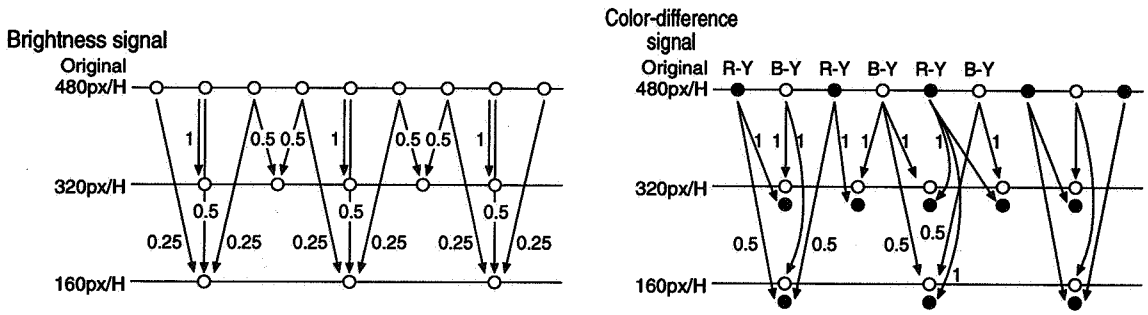


Fig. T-3 Conceptual Diagram of Interpolation

■ Color space conversion system

Color space conversion is accomplished by hardware in high color mode (R: 5 bits, G: 5 bits, B: 5 bits) and in pallet mode (256 colors selected). The color conversion data required for this process are written in advance from the PC to a DRAM.

The CCIF performs color conversion based on the color conversion data. The converted image data are buffered in the DRAM. The load on the PC's CPU is small because the image data do not need to be converted through software. This permits higher-speed data transfer, display, and storage in the PC.

■ Image transfer buffering

With the Windows 95 operating system, the PC may not be able to respond immediately to transfer requests from the camera, and may be involved in processing other programs while it is processing the camera load. The PowerShot30T is therefore equipped with a 4-megabit DRAM which serves as a buffer memory.

After interpolation and color space conversion, signal data are stored in the image area of the DRAM. Signal data are managed by hardware during this process so that consecutive motion video images can be transferred to the PC as they are sequentially recorded.

The CCIF has a 64-bit (length) × 16-bit (width) FIFO queue which compensates for the difference between the DRAM reading speed and the PC reading speed, making it possible to transfer data to the PC during the refresh cycle.

■ TG clock generation and frequency control

The CCIF has an external ×3 overtone crystal oscillator which provides a 38.1780 MHz main clock signal. The TG can provide a number of different fractional clock signals. With the PowerShot30T, the main clock signal is divided by six since a single field lasts 50 milliseconds (at 20 frames per second). At this clock speed, the monitor image is free of fluorescent flickering with both 50 Hz and 60 Hz commercial power supplies, even when the output is motion video.

■ Vertical transfer pulse shaping and control

A circuit is used to control the pulse width and the timing for generating each of two transfer pulses which transfer the contents of the vertical CCD; and to independently control whether or not to generate each pulse at every even/odd field. This circuit reduces image degradation during low-speed CCD driving, and makes it possible to shoot objects in low light through exposure during the long interval across two fields.

■ Electronic shutter control

The length of the pulses which are input to the TG SUBCNT terminal can be controlled through PC commands in order to control the CCD electronic shutter time. Exposure time changes every 1H (190 microseconds) over a period lasting 1/20 of a second (or as long as 1/10 of a second with 2V exposure). There is also a buffer for the SUBCNT command value. When this value is written at a particular time, the system is updated with that value at the start time of the next field.

■ Serial communication with the DIC

Communication with the DIC must be accomplished through serial access within a limited time period while maintaining video signal synchronization. The CCIF has a buffer which can hold data corresponding to three instances of communication. Once the communication contents and timing settings are made, a communication control function handles the communication process based on the set timing, and stores the communication results in the buffer.

■ Setting and reading various operating statuses through the register

An internal register makes it possible to control the I/O pins and the CCIF internal signal flow, to detect the couse of interrupt signals generated in the PC, to set values for various components, and to sense the status of those components. The release button status can be sent to the PC by assigning the input from PIO7 to an edge trigger interrupt.

■ Other circuits

- The DC/DC power circuit and regulator IC output can be turned on and off through register settings.
- An EEPROM stores parameters such as adjustment values which are set at the time the camera is manufactured. When the camera is turned on the camera driver software reads the adjustment values and writes them as D/A converter initial values or DIC initial values. This process reduces differences between individual cameras.

The features described above allow the PowerShot30T to be controlled with a high level of precision through the CCIF. The interpolation circuit, the large-capacity buffer, and the FIFO queue help minimize the load on the PC's CPU. These innovations allow the PowerShot30T to provide motion video and high quality still pictures in an inexpensive package.

2-3. Software

■ Overview of driver

The PowerShot30T driver is compatible with Windows 95 Plug and Play (PnP). This driver is designed as a capture driver which complies with the Microsoft Video for Windows (VFW) specifications and can be run on VFW-compatible video capture applications.

■ Driver block diagram

The following figure illustrates the driver block diagram.

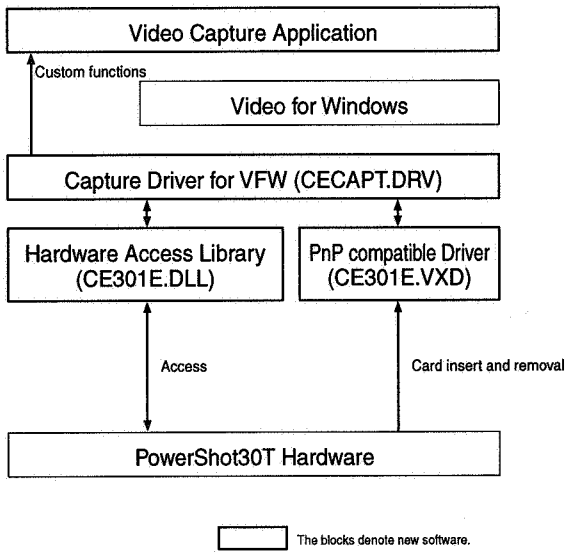


Fig. T-4 Driver Block Diagram

CECAPT.DRV : Capture driver which is compatible with Video for Windows. This driver can run on widely available applications which are compatible with Video for Windows. It also has functions which support the new capture application only.

CE301E.DLL : Library for accessing the PowerShot30T. This library handles tasks such as hardware initialization and image retrieval.

CE301E.VXD : Plug and Play-compatible driver. This driver detects when the PowerShot30T is inserted or removed from the PCMCIA slot, and handles resource requests and suspend/resume processes.

1. When the hardware access library (CE301E.DLL) senses that the PowerShot30T release button has been pressed, it notifies the capture driver (CECAPT.DRV) based on the timing of the image data copy being previewed.
2. The capture driver (CECAPT.DRV) posts messages for the message queue of the capture application.
3. The capture application handles posted release button message and executes the still image photographing sequence.

Note : The release button function uses the normal Windows messaging architecture. For this reason, general-purpose capture application which cannot recognize release message will not react to them. In such cases, still image photographing will not be supported. Only capture application which are designed to recognize release button message will work.

PARTS CATALOG and REPAIR INSTRUCTIONS

1. Before repairing the camera

1. Disassembly and assembly

The PowerShot30T does not have a very complicated structure. For this reason the procedures for disassembling and assembling the various service parts are not presented in this manual. See the exploded views for further information on disassembly and assembly.

2. Assembly checkpoints CHECKPOINT

Service parts which have assembly checkpoints are denoted by CHECKPOINT-* in the exploded views. Be sure to follow all of the checkpoints.

3. Adjustments ADJUSTMENT

Parts which require adjustments when replaced are denoted by ADJUSTMENT-* in the exploded views. Be sure to make all necessary adjustments (see page 7 in Section 5 (ADJUSTMENTS)). The following service parts require adjustments when replaced.

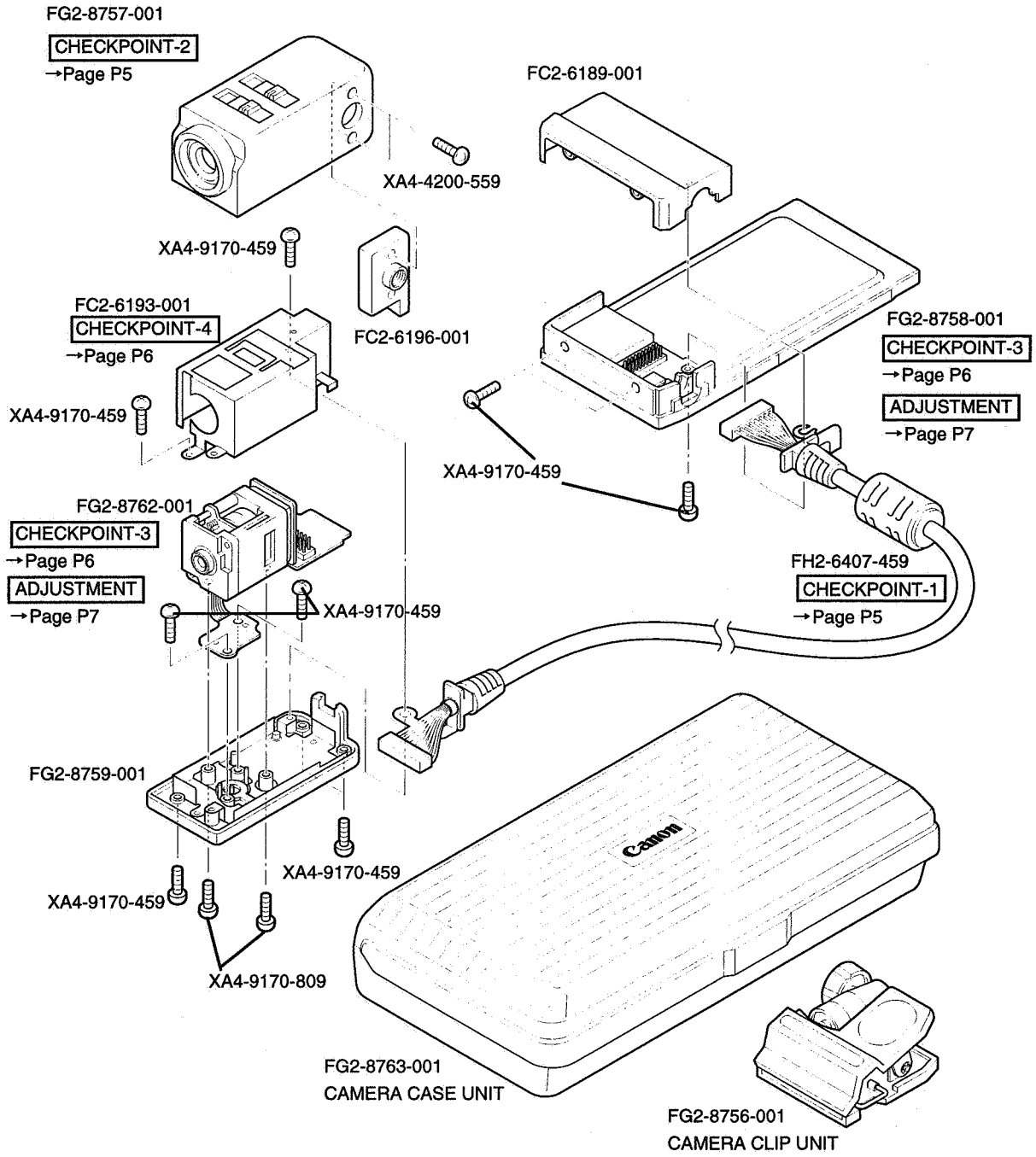
- MAIN PCB UNIT : FG2-8758
- CCD UNIT : FG2-8762

2. Measurement instruments and tools

• Precision screwdrivers	: Phillips and standard	(general-purpose screwdrivers)
• Adjustment software	: ADJ_PS30 (CY9-1532-000)	(set as service tool)
• Adjustment PC	: IBM ThinkPad 230 with PC DOS Version 6.3 or higher card service (e.g., PLAY AT WILL) should be installed. Note: This will not run on Windows 95 DOS. Alternative Notebook PC with PCMCIA slot	(recommended)
• Color viewer	: 5100°K, made by Dainippon Printing Co., Ltd.	(required)
• Color bar chart	: Made by Dainippon Printing Co., Ltd.	(required)
• Filter	: ø49 mm C2, made by Kenko	(required)
• Filter	: ø49 mm W12, made by Kenko	(required)
• Black cloth	: A dark cover should be used	(recommended)

3. Parts catalog

3-1. Exploded view



3-2. Parts list

REF NO. F92-1004

NO.	PART NO.	QTY	DESCRIPTIONS	RANK	PAGE
1	FC2-6189-001	1	TOP CASE, ABS	K	P3
2	FC2-6193-001	1	SHIELD, S	N	P3
3	FC2-6196-001	1	SOCKET, TORIPOD, PCG	H	P3
4	FG2-8756-001	1	CAMERA CLIP UNIT	K	P3
5	FG2-8757-001	1	CCD CABINET UNIT(A)	K	P3
6	FG2-8758-001	1	MAIN PCB UNIT	K	P3
7	FG2-8759-001	1	CCD CABINET UNIT(B)	K	P3
8	FG2-8762-001	1	CCD UNIT	K	P3
9	FG2-8763-001	1	CAMERA CASE UNIT	K	P3
10	FH2-6407-001	1	CAMERA CABLE UNIT	K	P3
11	XA4-9170-459	10	SCREW	G	P3
12	XA4-9170-809	2	SCREW	G	P3
13	XA4-4200-559	2	SCREW	G	P3

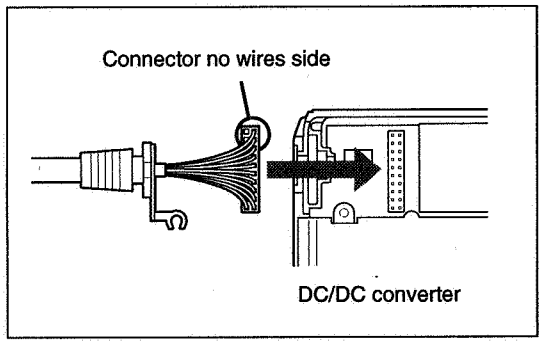
4. Checkpoints for repairs

CHECKPOINT-1

Attaching the camera cable unit

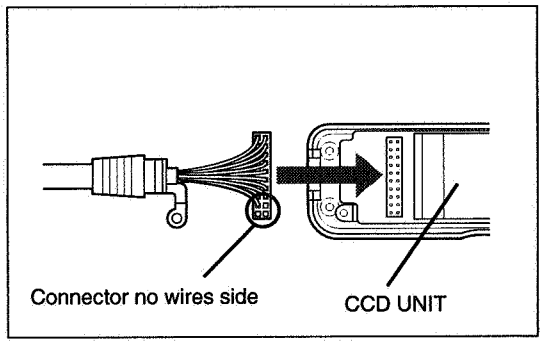
The camera cable unit connectors are not designed to prevent a wrong way plugging. Therefore be careful not to plug them wrong way around according to the following instructions.

- On main PCB unit:
  Attach the connector so that the connector no wires (two locations) side is on the left facing the DC/DC converter.



- On camera head:
  Attach the connector so that the connector no wires (three locations) side is on the right facing the CCD unit.

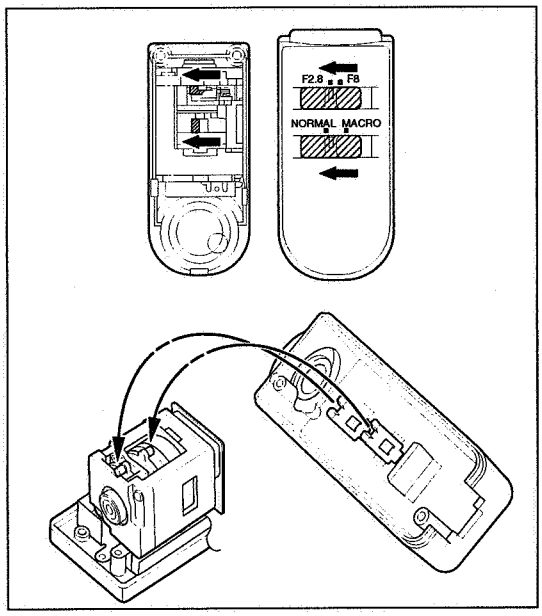
Important:
Be careful not to plug the connector wrong way around as this may damage the equipment.



CHECKPOINT-2

Attaching the CCD cabinet unit to the CCD unit

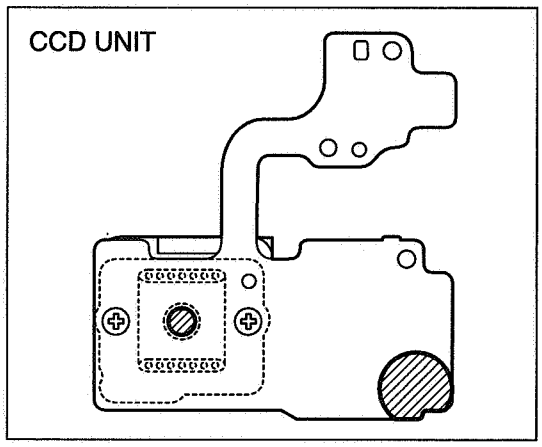
As shown in the diagram, turn the CCD unit's F-stop switch and focus switch and the CCD cabinet unit's F-stop switch and focus switch to one side. Then attach the units together.



CHECKPOINT-3

Checking the numbers and letters on the CCD unit

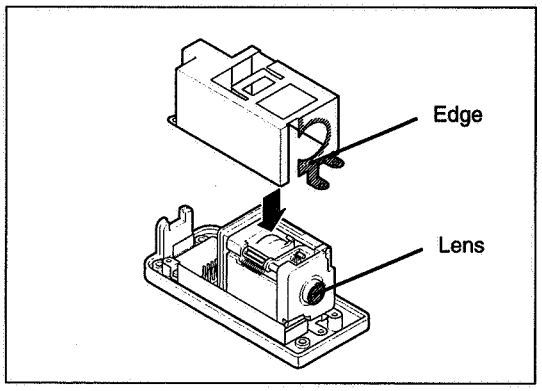
The CCD unit needs to be adjusted when the CCD unit and main PCB unit are replaced. This adjustment is made after the camera has been assembled and mounted on the PC. The numbers and letters on the CCD unit are needed for this purpose. Before assembly, be sure to check and make a note of the numbers and letters located on the CCD unit in the shaded area of the diagram.



CHECKPOINT-4

Attaching the shield

Be careful the edge of the shield does not scratch the lens on the CCD unit when attaching the shield.



5. Adjustments

5-1. Adjustment equipment and tools

• Adjustment software	: ADJ_PS30 (CY9-1532-000)
• Adjustment PC	: IBM ThinkPad 230 with PC DOS Version 6.3 or higher card service (e.g., PLAY AT WILL) should be installed. Note: This will not run on Windows 95 DOS. Alternative: Notebook PC with PCMCIA slot
• Color viewer	: 5100°K, made by Dainippon Printing Co., Ltd.
• Color bar char	: Made by Dainippon Printing Co., Ltd.
• Filter	: ø49 mm C2, made by Kenko
• Filter	: ø49 mm W12, made by Kenko Note: The Kenko filters are used for calibration. Do not use filters made by other manufacturers.
• Black cloth	: A dark cover should be used.

Use the equipment and tools shown above to make electrical adjustments. No mechanical adjustments are made.

5-2. Making adjustments

1. Preparations

- Start the PC in DOS mode after making sure that PC DOS and card service (e.g., PLAY AT WILL) are installed.
- Make sure the PC's date setting is correct.
- Age the color viewer (the viewer should be aged for about thirty minutes).
- Wipe the lens clean. Proper adjustments cannot be made if the lens is dirty.

2. Creating an adjustment date file

(1) Insert the floppy disk with the adjustment software in the PC.

(2) Set the floppy disk drive as the current drive, then enter 'GETDATE75'. A write file is created automatically.

ex)
```
C:/>
C:/>A:
A:/>GETDATE 75 (Enter Key)
>> System DATE: 1996:11:07
>> Wrote file [hexdate.txt].
A:/>
```

3. Starting the adjustment software

(1)Enter 'ADJ_PS30' and make sure the software starts running.

ex: A:/>ADJ_PS30 (Enter Key)

4. Insert the PowerShot30T in the PC for adjustment

(1)Insert the PowerShot30T in the PC. (The following message appears on the computer screen: 'Insert a card into a slot'.)

5. Enter the required data

The following message appears on the computer screen: 'Input data required'. Follow the screen prompt to enter the numerical data.

(1) Set the CCD Reset Gate Level.

The following message appears on the computer screen: 'Please Input CCD Reset Gate Level'. Enter the character sequence corresponding to the letters included in the CCD unit hexadecimal values and letters you wrote down before attaching the CCD unit. Use the following table as a reference.

Display	G	H	J	K	L	M	N	P	Q	R	S (Not displayed)	T	U	V	W	X	Y
Write value	5	20	3B	54	6E	7D	87	96	A1	B0	BA	C4	D3	DE	ED	F7	FF
Reference voltage	0.0	0.5	1.0	1.5	2.0	2.3	2.5	2.8	3.0	3.3	3.5	3.7	4.0	4.2	4.5	4.7	5.0

ex) Please Input CCD Reset Gate Level. :

Please Input CCD Reset Gate Level. : BA (Enter Key)

(2) Set the CCD Vsub Level.

The following message appears on the computer screen: 'Please Input CCD Vsub Level'. Enter the hexadecimal values included in the CCD unit hexadecimal values and letters which you wrote down before attaching the CCD unit.

ex) Please Input CCD VSub Level. :

Please Input CCD VSub Level. : 53 (Enter Key)

(3) Enter the product identification code.

Enter 'T:(r/t)' after making sure 'PowerShot30/30T:(r/t)' is displayed on the screen.

6. Black adjustment level

(1) Make sure the following messages appear on the computer screen: 'Cover the front lens with a black cloth to cut off coming light', 'Press a space key when ready'.

(2) Cover the entire lens with a black cloth to block out the light.

(3) Press the 'space' key.

(4) Adjustments are made automatically. The in-progress adjustments are displayed on the screen. The message shown below is displayed when the adjustment process is completed. If the adjustment process is not successful, 'NG' is displayed on the screen. If this happens, remove the PowerShot30T from its slot and repeat Step 4 'Insert the PowerShot30T in the PC for adjustment'.

7. Image adjustments

Preparations

(1) Make sure the following messages appear on the computer screen: 'Shoot a Color-Viewer', 'Press the space key when ready'.

(2) Align the PowerShot30T lens to be adjusted with the color viewer. Set the photographing distance to approximately 45 cm. (Fine adjustments are made later.)

(3) Set the lens F-stop to F2.8.

(4) Press the 'space' key.

(5) Shoot the color viewer.

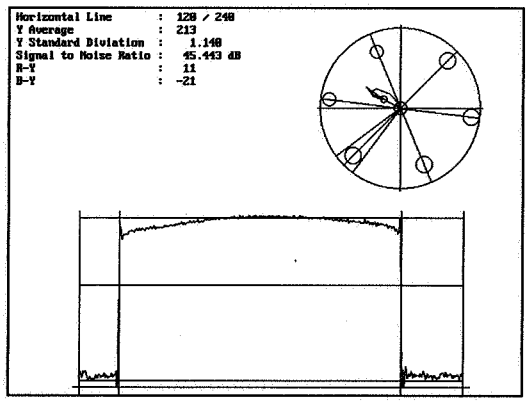
(6) The image which is currently being taken by the PowerShot30T is displayed as a mosaic with a white border in the upper right part of the screen. Adjust the color viewer position so that it appears one size smaller in the display area while viewing the image.

(7) Press 'q' or 'Esc' key.

Before making subsequent adjustments, fasten the PowerShot30T camera and color viewer in position so they will not move.

White balance adjustment (Part 1)

After completing the above preparations, close the preview screen on the monitor. The white balance adjustment process starts automatically.



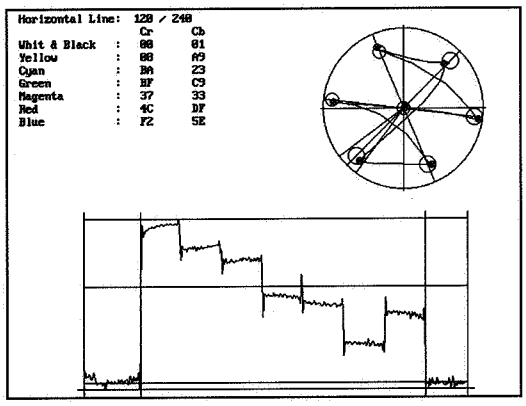
The adjustment software handles white balance adjustment automatically. Wait for the message shown below to be displayed on the screen. If the adjustment process is not successful, 'NG' is displayed on the screen. If this happens, remove the PowerShot30T from the slot and repeat Step 4 'Insert the PowerShot30T in the PC for adjustment'.

Color adjustment

(1) Make sure the following messages appear on the computer screen: 'Shoot a color bar chart', 'Press the space key when ready'.

(2) Set the color bar chart on the color viewer so that white image is on the left and blue image is on the right on the screen.

(3) Press the space key. The automatic adjustment process starts.



(4) Wait for the automatic adjustment process to end and for the message shown below to be displayed on the screen. If the adjustment process is not successful, 'NG' is displayed on the screen. If this happens, remove the PowerShot30T from the slot and repeat Step 4 'Insert the PowerShot30T in the PC for adjustment'.

White balance adjustment (Part 2)

(1) Make sure the following message appears on the computer screen: 'Place a W12 filter in front of the lens, then shoot the Color-Viewer'.

(2) Place a W12 filter in front of the lens. (Convert the color temperature).

(3) Press the 'space' key. The automatic adjustment process will start.

(4) Wait for the automatic adjustment process to end and for the message shown below to be displayed on the screen. If the adjustment process is not successful, 'NG' is displayed on the screen. If this happens, remove the PowerShot30T from the slot and repeat Step 4 'Insert the PowerShot30T in the PC for adjustment'.

White balance adjustment (Part 3)

(1) Make sure the following messages appear on the computer screen: 'Place a C2 filter in front of the lens, then shoot the Color-Viewer', 'Press the space key when ready'.

(2) Place a C2 filter in front of the lens. (Convert the color temperature).

(3) Press the 'space' key. The automatic adjustment process will start.

(4) Wait for the automatic adjustment process to end and for the message shown below to be displayed on the screen. If the adjustment process is not successful, 'NG' is displayed on the screen. If this happens, remove the PowerShot30T from the slot and repeat Step 4 'Insert the PowerShot30T in the PC for adjustment'.

Writing data to the EEPROM

(1)Make sure the following message appears on the computer screen: 'Write data into the EEPROM'.

(2)Press the 'space' key. The process of writing the adjustment data to the EEPROM will start. One of the following messages appears when the writing process is completed.

OK : This message indicates that the adjustment process has been completed. Remove the PowerShot30T from the slot. If there is another PowerShot30T unit requiring adjustment, you may proceed with that unit. To exit the adjustment software, press the 'Esc' key.

NG : This message indicates the adjustment process has failed. Remove the PowerShot 30T from the slot and close the adjustment program, then start over with Step 2 'Creating an adjustment date file'.

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QA Systems Development Dept 4.

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